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+ OCCURRENCE OF SALMONELLA ORGANISMS IN DEHYDRATED EGGS AND  
= THEIR TOXICITY TO HUMANS //

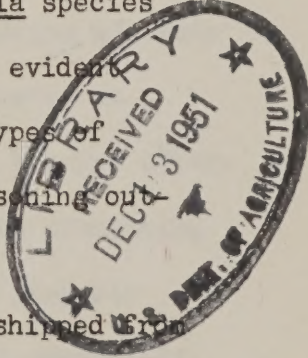
By

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Status of the problem:

The fact that many members of the Salmonella group are pathogenic for man is nothing new, this has been known for over 60 years. Salmonella is the name applied to a group of bacteria which are known to occur in man and animals and animal products. Many of these bacteria are related to the typhoid organism but differ from the latter in that they do not produce typical typhoid fever, but rather gastro-intestinal and other symptoms which are sometimes referred to as "food poisoning" symptoms. In man these symptoms in most cases may vary in severity from mild brief enteritis to serious prostrating illness. Recent investigations have made significant new knowledge available on the part that Salmonella species play in food poisoning. The complex nature of the problem is evident from the fact that there are over 150 recognized species or types of Salmonella and that 50 of these may be implicated in food poisoning outbreaks.



During World War II large quantities of egg powder were shipped from the United States to other countries. In this period, sporadic outbreaks of alleged food poisoning were reported to occur and in some instances dried eggs were suspected as being the agent responsible. Since the connection between dried eggs and Salmonella poisoning was based largely at that time on circumstantial evidence, research was undertaken by the U. S.





Department of Agriculture to consider the question thoroughly from a bacteriological standpoint. During these studies, a number of facts have been brought to light.

A most significant finding was that examination of more than 5,000 samples of spray-dried whole egg powders of 4-6% moisture revealed a rather high incidence of contamination with Salmonella organisms. Naturally clean eggs are relatively free of the organisms but dirty and low-quality eggs may show significant contamination. Washing the shell does not always eliminate the contamination as the bacteria may be found in the interior of the egg. While the incidence of Salmonella bacteria in fresh shell eggs is extremely low, a few contaminated eggs when mixed with thousands of broken-out eggs in a single container for the purpose of preparing dried egg powder will contaminate the entire batch. Although the number of authentic outbreaks of food poisoning traceable to dried egg powders has been remarkably small considering the very large quantities of egg products consumed, the presence of Salmonella organisms in these products and the question of their possible pathogenicity has caused concern among agencies interested in public health. This concern is based entirely on the possible harmful effect of inadvertently consuming raw or improperly cooked egg products containing Salmonella organisms. There is no concern with these products properly handled. It is well known and the fact should be stressed that adequately cooked eggs or egg powders contain no living Salmonella bacteria and therefore constitute no possible public health hazard that can be visualized in the light of present knowledge.





Pathogenicity of Salmonella from spray-dried whole eggs:

The fact that certain bacteria of the Salmonella group have been shown to occur in dried egg powders has made it necessary to determine definitely whether or not these bacteria are capable of producing illness in humans. Information on this point has been obtained and constitutes an additional important finding of research directed by the Bureau of Agricultural and Industrial Chemistry toward this problem. This work, undertaken through contract research with the University of Chicago, conclusively establishes the fact that six strains of Salmonella isolated from spray-dried whole eggs are pathogenic for humans. During the experimental studies resulting in clinical Salmonellosis in volunteers it was determined that the number of organisms required to produce illness was in all instances within the range which might conceivably be encountered, particularly from reconstituted egg that was prepared from high moisture powder (4% or more) which had been allowed to stand several hours at room temperature and not subsequently been subjected to adequate heat treatment.

Elimination of Salmonella bacteria from liquid whole egg before drying:

Since research has conclusively demonstrated the fact that contamination of large batches of liquid whole egg may occur in the mixing operation prior to dehydration and that some of the Salmonella strains found in spray-dried whole egg powder are pathogenic to man, it was necessary to develop means to insure elimination of such organisms from liquid whole egg before drying. It has recently been determined as a result of work undertaken by the Production and Marketing Administration, U. S. Department of Agriculture, that the pasteurization technique appears to be the most





feasible method for the elimination of Salmonella types of bacteria from liquid whole eggs. Results from this study show that by the use of accurate temperature controls and the employment of reasonable and attainable operating techniques the elimination of Salmonella bacteria can be accomplished. Moreover this goal can be attained under commercial plant operating conditions and with untrained labor. Mechanical equipment designed for the pasteurization of milk can be converted to the pasteurization of liquid whole egg without alteration of the equipment.

While elimination of Salmonella bacteria can be accomplished through pasteurization, temperatures below 135 degrees F. do not accomplish bacterial killing and temperatures above 145 degrees F. produce excessive coagulation of the egg protein which interferes with proper heating efficiency. The temperature of 140 degrees F. with a holding time of 3 minutes has been found to be satisfactory for the elimination of Salmonella types of bacteria and provides a margin of safety in operation. Although satisfactory results can be expected from this method, observations on plant operations point to the desirability of incorporating recommendations into the operating program covering (1) installation of an educational program for the plant personnel to stress the necessity for maintaining accurate temperature control and proper rate of flow of liquid to govern the required holding time, (2) installation of accurate temperature control equipment and a program to keep it in adjustment, (3) installation of continuous temperature recording devices to provide permanent records of the temperatures used, (4) segregation of all unpasteurized products, and (5) establishment of a systematic operating schedule.

Until a satisfactory method for the elimination of Salmonella is





universally employed by industry in the production of spray-dried whole egg powder and all important questions have been answered, it is essential that research and other efforts on the broad problem be continued. It would be highly important, therefore, to stress studies bearing on the microbiological health hazards that might arise from small numbers of human pathogens in prepared egg foods and to improve our methods in gaining further knowledge in connection with this problem. Studies should also be stepped up on the effect of pasteurization and other treatments on the various constituents of eggs and their products and on their quality. Techniques developed by the Bureau of Agricultural and Industrial Chemistry in cooperation with the Quartermaster Corps have demonstrated advantages so far as quality and storage stability are concerned in the removal of glucose from whole egg prior to dehydration. This procedure, which is described in another paper to be presented at this Conference, is in itself quite effective in reducing the number of Salmonella organisms in the final product. It would be reasonable to assume that a combination of glucose removal and pasteurization would assure the production of a microbiologically safe and high quality dried egg powder. The work in mind should be directed toward this objective. In the mean while producers and processors in the United States are energetically trying and will continue to attempt to minimize infection of Salmonella in poultry flocks and in pockets of contamination in the processing procedures. An ultimate industry goal is to eliminate Salmonella-infected eggs at their source. It is also suggested that an interim solution to the Salmonella problem might be to educate the public to use cooking or preparation techniques that will destroy these organisms.





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